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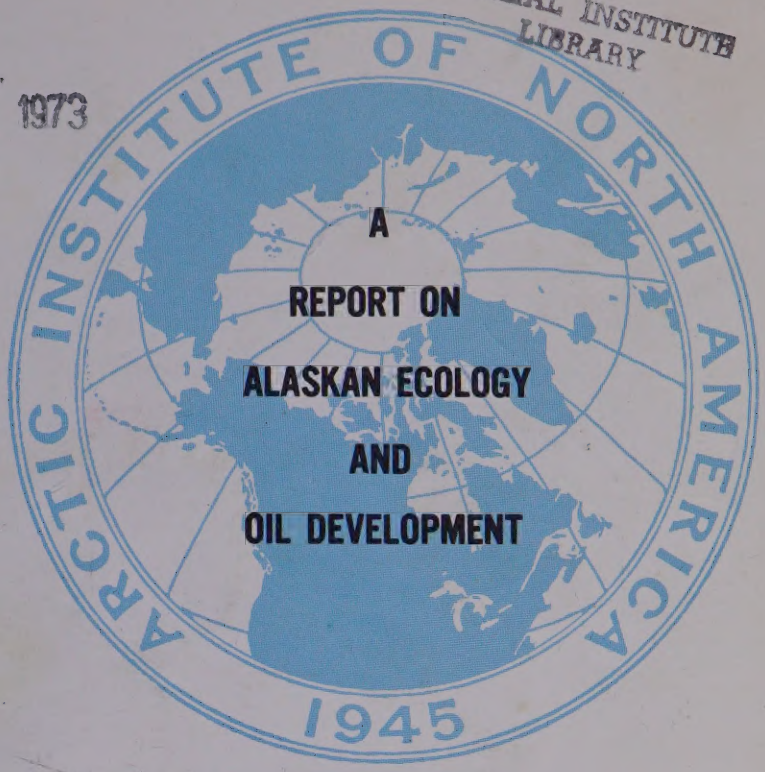

A REPORT ON ALASKAN ECOLOGY AND OIL DEVELOPMENT

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A REPORT ON ALASKAN ECOLOGY

AND OIL DEVELOPMENT

Lectures delivered at the
Tenth Annual Meeting of
The Arctic Institute of North America
Washington, D. C.
February 18, 1970

THE ARCTIC INSTITUTE OF NORTH AMERICA
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INTRODUCTION

It has become customary over the years for the Arctic Institute to hold a meeting in Washington about once a year, usually early in the spring. To these meetings are invited the membership of the Arctic Institute in the Washington area, friends of the organization, many of the people with whom the Institute has business or social connections, and official and non-official groups and individuals who seem to have a special interest in the subject to be discussed. The Institute attempts to have the evening revolve around some subject of northern interest that currently is in the public eye. In 1970 the Institute selected as the topic of the meeting some of the aspects of the exciting development of major petroleum deposits in northern Alaska. Curiously, the unique development of the oil industry in the 49th State coincides with the rapid increase in the public conscience of interest and concern about our environments. Ecology is a word with which everyone is now familiar and it appears constantly in the press and on the television screen. Also there is great interest in the petroleum development in northern Alaska, in the problems of people and communities associated with that development, and with the tundra environment.

The three lectures of the Tenth Annual Meeting were delivered by distinguished individuals who are knowledgeable about various aspects of the overall situation. Dr. Johnson is an ecologist and his paper develops that interest. Dr. FitzGerald is an official of the Atlantic Richfield Company and to that extent his remarks represent the industry's viewpoint. Finally, Capt. Smith is the Director of the Naval Petroleum and Oil Shale Reserves and as such currently is the landlord, so to speak, of about half of northern Alaska, Naval Petroleum Reserve No. 4.

ECOLOGICAL STRATEGIES OR TECHNOLOGICAL TRAGEDY IN THE ARCTIC

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A thought-provoking perspective of spaceship earth was brought to our television screens in 1969 by the astronauts on the moon. That event symbolized a tremendous technological achievement, but it also posed new questions for all of us about life on earth and about our more earthy values. The sarcastic view of our civilization was voiced by Philip Wylie (1968) when he wrote, "Modern man is probably the most ignorant example of his species ever to exist." A reappraisal of the relationships of man to his resources is now in process. That our educational and economic systems have failed to convey a balanced, enduring perspective is evidenced by the enthusiastic embrace of the environmental issue by both youth and politician. People are concerned for we are seemingly poisoning the world in many ways. We now question the axiom that more is necessarily good.

We witness daily changes of many kinds in our lives and to our world. In our frustrations, the public speaks loudly against today's technology and and indeed the science that man hath wroght; we would shout more loudly if that science were to suddenly evaporate. Let us also recall the once-productive Near East, cradle of Western Civilization, and Jeremiah 2:7 which says, "And I brought you into a plentiful country to eat the fruit thereof, and the goodness thereof; but when ye entered ye defiled my land and made mine heritage an abomination."

Man has changed his standard of living and his environments continuously for centuries. Resource exploitation has produced affluence for greater numbers of people. We acknowledge that many of these changes were irreversible for both man and beast and that resource depletion and rise in affluence have apparently been most rapid in America. Many voices now suggest that "growth of American society" has meant an exchange of quality of life for a standard of living. We now seek to define those elusive lost values of quality of life.

In a time of technological affluence these are sobering thoughts to a free world with rights for all and all of us insisting upon our rights. We view nature as a part separate from ourselves. Our technology is thought to isolate us from nature, whereas in fact it makes us more dependent and more vulnerable. Further, we relate to nature at the organism level because we are organisms (Figure 1). Much of science has developed from a reductionist philosophy and has progressed according to its ability to measure smaller and smaller matter. Synthesis into units larger than organisms - that is, populations, communities, and ecosystems - is more complex, less developed, but vital to civilization (Figure 2). It is the concern of ecology.

Life on earth exists in a relatively thin layer of soil, water, and atmosphere near the surface of the planet, the biosphere. The interactions of these environments and the life they support are the concern of modern ecology. The whole biosphere can be divided into spatial units of varying sizes, called ecosystems. Man is a part of some of these ecosystems and his activities influence most ecosystems; and man, like all organisms, lives in and places demands on the environment. One of the gravest problems facing man is the establishment of a reasonable harmony between a stabilized human

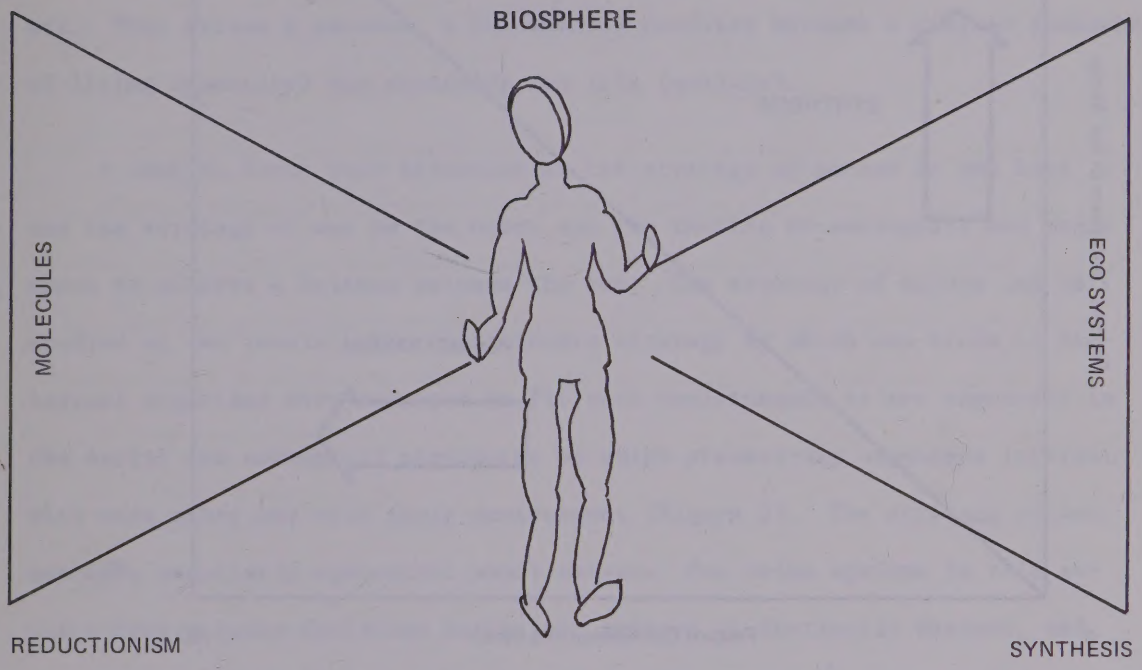

FIGURE 1

People tend to view nature from the organism level. Science studies nature from a reductionism philosophy, that is dividing it into smaller and smaller componants, and from a synthesis philosophy, grouping the parts to understand the whole.

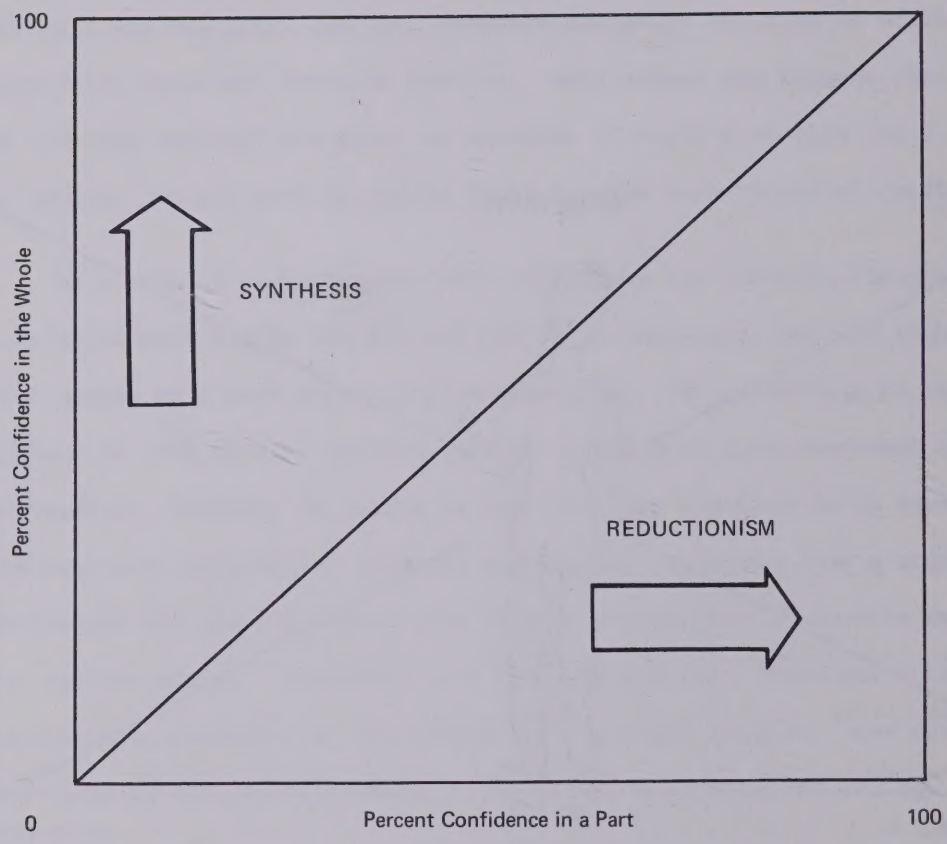

FIGURE 2

Two approaches to understanding nature lead to varying confidence or information about whole eco systems as opposed to its parts. These two philosophies are complimentary and essential for resource management.

population and the environmental resources upon which that population depends. Technology is altering environment and biological populations at an increasing rate. Less often identified, but perhaps more significant than birth or death rates, is the redistribution of people, particularly their concentration in urban sprawls. This trend is a chronicle of human history. So is the parallel concentration of wealth and too often a consequent demise of human values. Thus arises a paradox, a fundamental conflict between a desired standard of living (quantity) and standards for life (quality).

I want to focus your attention on the strategy of nature on one hand and the strategy of man on the other and the tactics of ecologists and engineers to achieve a balance between the two. The strategy of nature can be studied at two levels: the evolutionary strategy by which new kinds of biological organisms were selected to fit such environments as are expressed in the Arctic and ecological strategies by which present-day organisms interact with each other and with their environment (Figure 3). The strategy of man has been peculiarly egocentric about nature. Our value systems in this society have a Judeo-Christian basis, our science is distinctly Western, and our dominant attitude is self-righteous about man and certainly exploitive about nature. As White wrote in 1967, "Despite Darwin, we are not in our hearts, part of the natural process. We are superior to nature, contemptuous of it, and willing to use it for our slightest whim....Hence we shall have a worsening ecologic crisis until we reject the Christian axiom that nature has no reason for existance, save to serve man."

For most people, arctic regions exist only on maps; for a few men, arctic lands represent undeveloped resources. Man long ago went to the Arctic for seal skins and whale oil and to be the first Americans. Some really were the

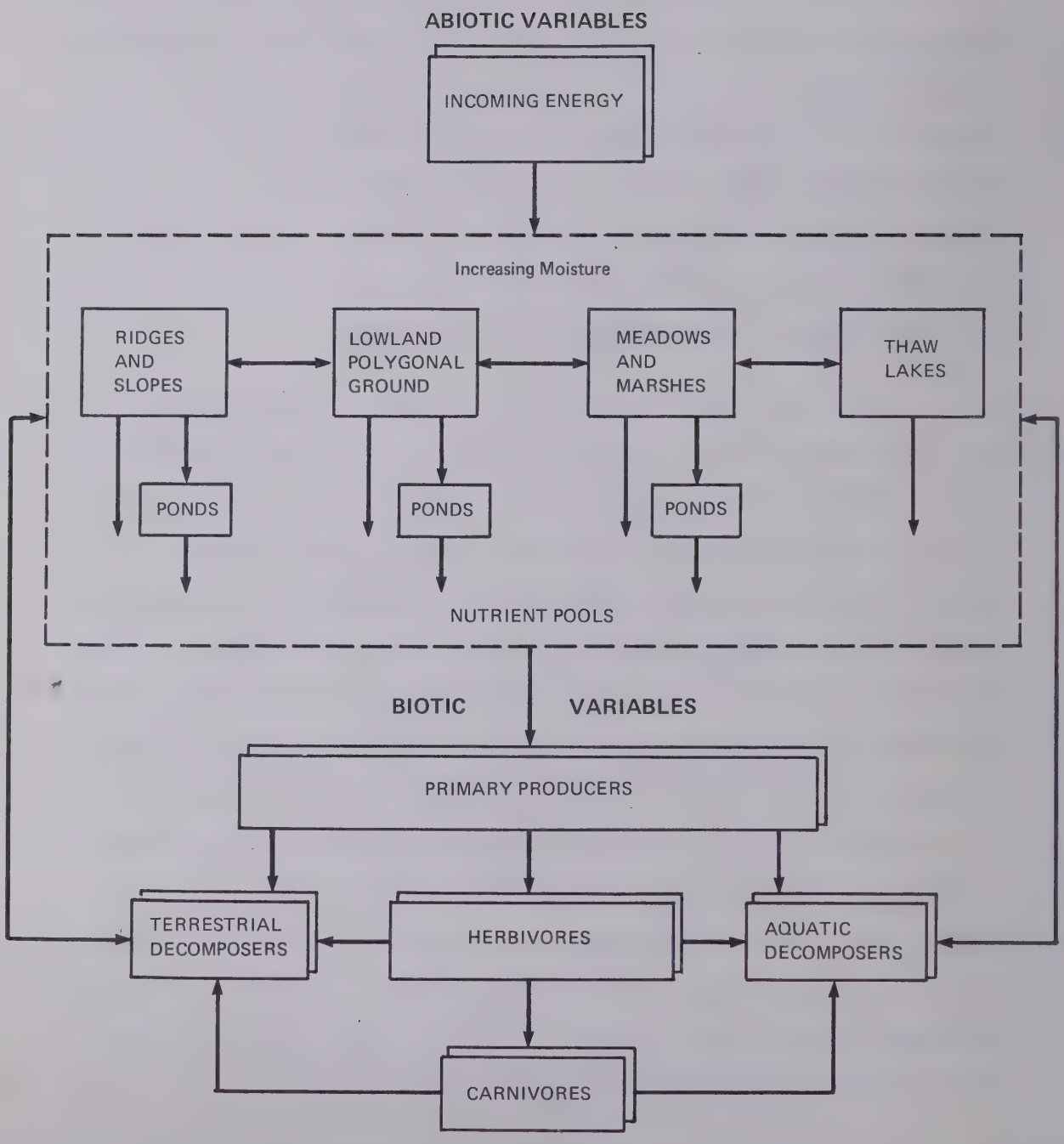

FIGURE 3. Conceptual diagram of a wet tundra ecosystem. (Courtesy of IBP-Tundra Biome project.) Further identification of ecosystem components and transfer paths have been developed.

first Americans, ten thousand years ago. Today, exploitation of arctic oil in Alaska is a major challenge not only in engineering and economics and ecology, but also in the ethics of the commons. You will recall Garrett Hardin's (1968) discussion of the public common that was soon exhausted by too much abuse by each freeholder placing just one more cow on the village green. That which best served the individual collectively deteriorated the resources of the community. There are the Alaskan commons on which the impact of oil exploration, extraction, and transportation is developing. There are also the common airsheds and watersheds of the world into which some percent of those fossil hydrocarbons will ultimately go. In this respect arctic oil is a double-barrelled infringement. It is up to all of us to decide whether this challenge in Alaska today is poor ecological strategy with subsequent technological tragedy or whether it can be sound ecological strategy to avoid such tragedies.

It is clear that our understanding of the biosphere is inadequate, although essential. It is also true that we often prefer to ignore known facts as in the case of DDT. Critical knowledge about environment and about organisms has not been man's first priority. Nor is the amount of critical information to sustain spaceship earth readily obtainable. We do not know for any ecosystem the minimum number of kinds of organisms required for man's survival, for orderly regeneration, regulation, and self-cleansing necessary to perpetuate living systems.

Over one hundred years ago this country built its first transcontinental railroad. The federal government subsidized two companies to build track, one toward the west, one toward the east. Insufficient thought was given to just where east and west were to meet. Since the companies were paid by the

mile, they continued to build after they first met west of Brigham, Utah. Congress finally agreed on the spot for the golden spike by which time construction activities of the two companies overlapped by 200 miles at taxpayers' expense. I am concerned that arctic oil fields are being developed with similar speed, economic motivation, and insufficient planning. Although there is considerable private and government planning, the trans-Alaska pipeline sections were purchased and partially delivered before meaningful consideration of the diameter of the pipeline was possible. Thus did a four-foot-diameter pipe become the only option.

We have been mesmerized to accept economic solutions to environmental problems. We have been led to believe that economic laws of supply and demand eventually account for all tangible values. More recently as environmental values have attained a rapid political profile, we began to recognize values independent of the dollar sign. Aesthetic yearnings usually cannot be purchased. Such intangibles in life may acquire a dollar value after it is too late, near extinction, or irreversibly poisoned. Such hidden costs of secondary effects such as air and water contamination are usually imposed upon the general taxpayer. Ketchum (1969) has provided an interesting approach to analyzing benefits, hidden costs, and alternatives to several types of ecosystem management problems.

Many of the experiences and much of the research supported by the Navy from 1944 to 1953 on Naval Petroleum Reserve No. 4 is applicable to current oil and natural gas development problems in northern Alaska. A considerable amount of information is directly available or inferrable for the North Slope of Alaska. Clearly research has continued since the original explorations under various sponsorships, particularly that of The Arctic Institute of North

America.

Our knowledge of arctic ecology has been recently summarized in a special symposium published in the fall issue of Arctic. Certainly our ecological insight has been sharpened by contrasting arctic with alpine ecosystems (Billings and Mooney 1968; Bliss 1956, 1962, 1969; Johnson 1969). For example, comparison of energy budgets at the height of the tundra growing season at a very high solar load in the White Mountains of California, Latitude 37°N., (Terjung et al 1969) with similar values at Barrow, Alaska, Latitude 71°N., (Kelley and Weaver 1969) show arctic total global radiation to be 52% and net radiation 58% of alpine values. In spite of reduced intensity, the effect of solar warming of frozen tundra is one of the major engineering concerns in interior and northern Alaska. Some experimental results were reported by Brown et al (1969), and further controlled experiments in which the heat budget and ecological response are measured following various kinds of tundra disturbance are planned in 1970. Figure 4 illustrates normal differences in air temperature within a few miles on the Alaskan North Slope. Clearly such normal variations in nature must be distinguished from treatment effects in any assessment of technological impact. One type of adaptation by plants to tundra conditions is shown by Arctic Bistort (Figure 5) which stores large amounts of food reserves in a rhizome for very rapid growth immediately following snow melt. We do not know the rates of recovery of vegetation or of aquatic ecosystems following perturbations resulting from resource development. Traffic damage is now a prime concern; a larger one may be solid waste disposal.

Originally the Navy Department, as steward of a very large tract of public domain (37,000 square miles) needed to know the extent of petroleum reserves in Pet-4. An estimate was obtained along with a great deal of

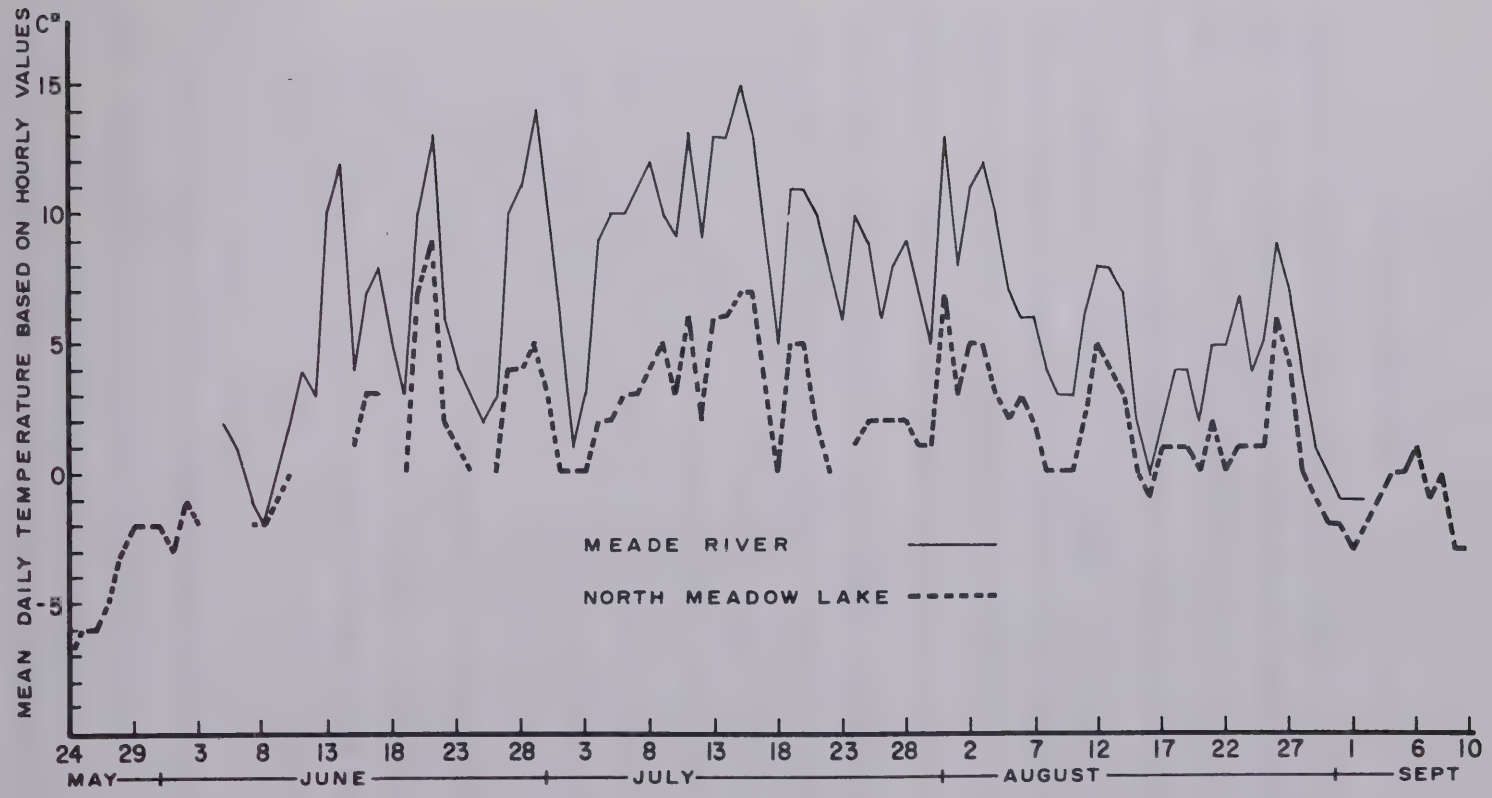

FIGURE 4. Mean daily air temperature one meter above tundra at a coastal station and at a station 46 kilometers inland in northern Alaska during the 1966 growing season. The consistantly higher inland temperatures are probably due to less cloud cover and therefore higher total global solar radiation. A shallow snow cover prevailed during most of the other months of the year.

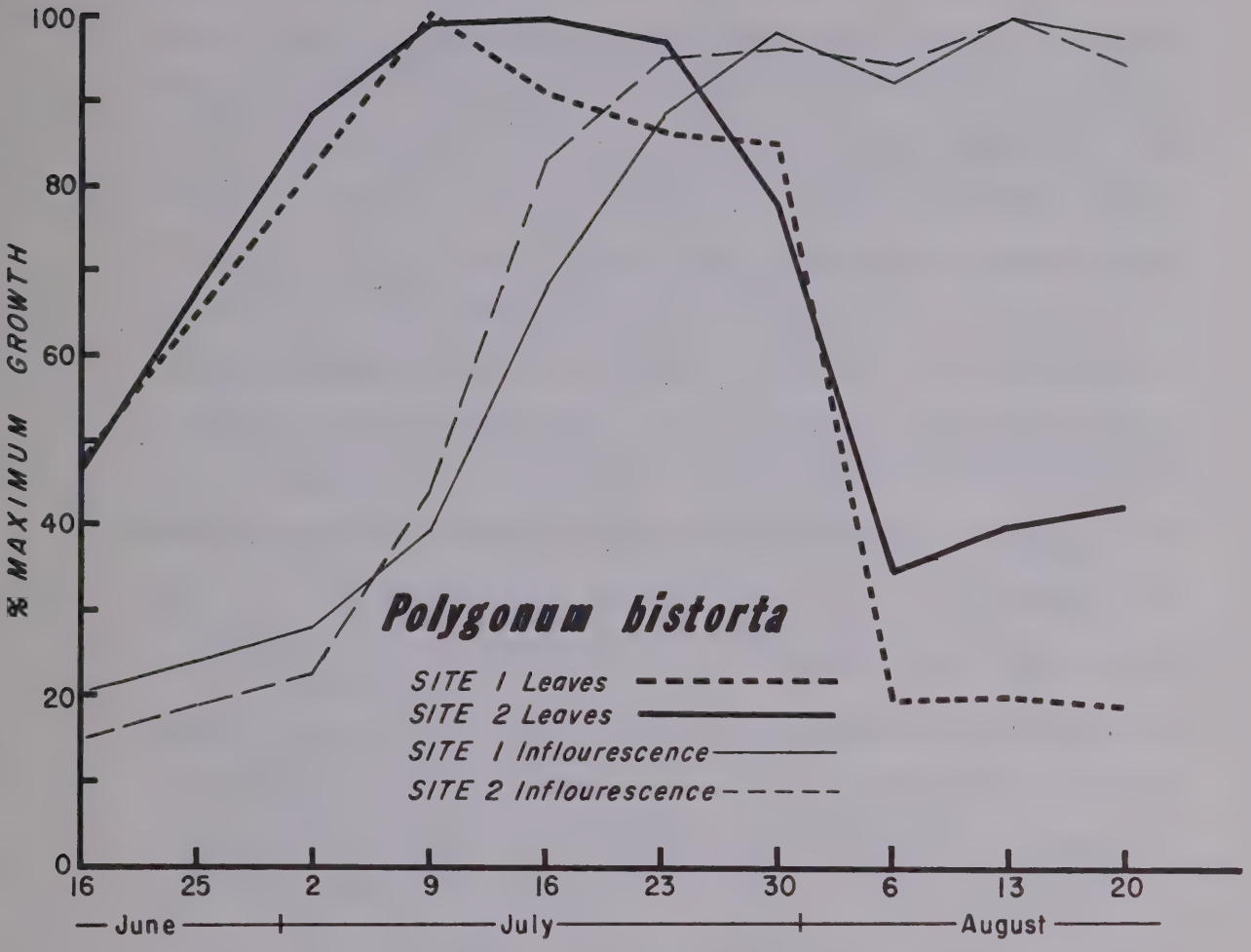

FIGURE 5. Growth rate of Arctic Bistort from weekly measurements of elongation by 20 plants at Meade River, Alaska in 1966. This plant exemplifies the accommodation of the carbohydrate cycle to a short growing season (Mooney and Billings 1960). Four phases of the life cycle are distinguishable. Food reserves stored in the rhizome permit rapid development of a photosynthetic surface. Then current carbon fixation permit growth of a reproductive structure. In a third phase during August, photosynthates are removed from leaves for seed maturation and to restore carbohydrates in the rhizome. The leaves actually shrivel during this period. During the dormant period there is a slow drain of carbohydrate reserves in the rhizome by respiration.

logistic experience and ancillary knowledge of other biological and geological resources. Now that active development of producing oil wells is in progress adjacent to the Reserve, re-evaluation of the public resources is indicated. The new dimensions arise from problems attendant to "development;" these include engineering, economic, ecological, environmental, and even educational and sociological issues. They involve local, state, and federal groups, both public and private. The turmoil generated in Alaska among corporations and among agencies is a challenge of rare proportion. The collective response may be chaotic or it can lead to intelligent planning to achieve solutions to drilling problems, living problems, and transportation of oil, people, and other materials. For the Alaskan economy to stabilize will require cooperation and planning at a depth and scale not usually practiced in this society.

Multiple use is feasible in some ecosystems up to certain intensities of use for specific combinations of activity. Clearly many other combinations of resource management are not compatible and do result in environmental deterioration. It then becomes mandatory to zone landscapes for various activities as we do in urban areas as suggested by Odum (1969). As the intensity of resource use increases so does the necessity for a definable strategy for living.

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COMMUNITY DEVELOPMENT

IN HARMONY WITH THE ENVIRONMENT

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As a boy I read everything I could about the Arctic. My father had gone to Nome in the Gold Rush, and I thought of the North as the great land of adventure. And so it was. The land, the climate, the distances, all made entry into the country dangerous and challenging and also high adventure. That day is gone. One by one we have reduced the hazards - distance by the airplane and helicopter; cold and wind by the building of totally enclosed, climate-controlled communities. Suddenly the challenge is one of bringing man's activities into harmony with the environment.

When I was asked to talk tonight about community development in the Arctic, I realized that it was a subject that had to be viewed in an entirely new perspective, one that involved the application of scientific knowledge and modern engineering practices to solve human and environmental problems for which the past offered few if any precedents. Viewed in this light, we do not find a solid body of literature or doctrine to give us the answers. There are descriptive articles on specific topics, such as Russian cities in Siberia or the programs which the Canadians are initiating for their native people in the North; but a solid analysis of why man is in the Arctic, what he can do there, and how he should do it is yet to be written. It is clear that we need a new philosophy for man in the Arctic - a philosophy that will encompass his social, cultural, and economic life in harmony

with the rigid requirements of an environment that is in some ways tough and resistant and in other ways fragile and delicate.

I do not have the outline of such a philosophy for you tonight, but I have been privileged to be close to planning in Alaska for a number of years and, more recently, to the development of communities for the oil companies on the North Slope and to the very great efforts which they are making to solve the problems of man living and working in the toughest environment in North America. I would like, therefore, to approach the problem of northern development in a simple framework by reviewing the current scene and by projecting where it is all going in the decade ahead.

National focus on the Arctic for any purpose other than military is recent. Three years ago, only the tourists, the scientists, and government personnel went into the Far North, usually in the summer, while the small native population carried on much as they always had. There was little other activity. This was true despite geological reports that promised major finds or the increasing unhappiness of the native peoples caught tragically in a declining subsistence economy and unable to get an adequate toehold in the more abundant economy of America. But with fewer than 10,000 people living in 18 villages north of the Arctic Circle, and fewer than 2,000 of these on the North Slope, neither the resources of the area nor the plight of its people seemed able to command much national attention.

Quite suddenly three powerful forces thrust the North into national prominence. The native people put forward their claims to land and compensation for lands taken from them, and America listened. At the same time, oil was discovered on the North Slope in quantities that could make Alaska a

principal source of petroleum for the United States. Finally, the nation became aware of the environmental challenge to man's survival on earth. These forces, each powerful enough to cause fundamental change, will govern whatever level of development is attained in the North.

We believe the task will be easier because industry understands the challenge and can meet it in its sphere of operations. We also believe that a wise solution of native land claims will give them lands that will underwrite a start towards a new way of life. Finally, there is the hope that government will do better with its assistance in the field of native housing, which, for all the past efforts, threatens to remain the least resolved area of community development.

As a subject of broad public planning, community development in the Arctic is relatively new. Until World War II we had not begun to accumulate the basic scientific knowledge or the engineering solutions to environmental problems that large-scale community development requires. What was done in early days as the white man pushed into the Arctic was tolerable only because so little was done that the impact was hardly visible, but it was not good from an environmental standpoint.

Man has, of course, inhabited the Arctic for thousands of years and, in order to survive, has had to have housing. He built with ingenuity, but he had only a limited technology and an even more limited range of materials. Typically, his solution was the hogan, half dug into the earth and made of rocks, sod, skins, driftwood, and whale bones. In more recent times, he moved to a frame or log house based on the traditional housing of the white man. Unfortunately, the change was not entirely successful, and marked no

great progress. That the Eskimo shared this viewpoint is well illustrated by the story attributed to one of the Eskimo leaders at a conference on housing. In his words, "Before the white man came, my people lived below ground and buried their dead above ground. When the white man came he taught us to live above ground and bury our dead below ground - and we haven't been warm since."

The Eskimo's complaint is now well documented. But what is important to recognize here is that, if we are to talk meaningfully about community development in the Arctic, we cannot look to the past. Rather, it is necessary to look to modern designs which have been employed in some form of comprehensive building program - what the Russians have done in Siberia, what the Danes have done in order to house the native peoples of Greenland, or, in this country, what the military has done since World War II in northern Alaska, and what is currently being done by the oil industry at its base camps.

The Russian experience is important because it involves the construction of large communities integrating a full range of social, cultural, and economic activities of a population permanently inhabiting an area. They have proved that this is technically possible, although it presents serious problems. Top management and technical personnel who have freedom of choice tend to remain for only a limited assignment because the Arctic is not really an attractive way of life for most people. What they have also shown is the very high overall cost of carrying out economic development by establishing large communities. The lesson we learn from them is that it is more efficient and more acceptable to build only the specialized facilities needed in the North and to keep the number of people and period of assignment to the

minimum, relying instead on a rotation of personnel from a back base, such as Fairbanks or Anchorage or Barrow in the case of natives from that area. The result is not only the development of compact communities but the development of communities that have less than 20 percent of the people that would be required in a community that carried out all the functions of a normal city.

The Danish experience is equally important, but to government rather than industry. Their effort has been to give a whole group of people - in this case the native population of Greenland - a sound economic base and a much higher standard of living. This was done by developing a fishing industry and constructing new towns around the fishing ports. The U. S. could study this experience in connection with the rebuilding of Barrow and native centers such as Kotzebue, Nome, and Bethel. The Danish experience could also be of value in state planning if large-scale mining develops in the Brooks Range. Mining, unlike petroleum production, requires a large labor force and, being in a more favorable climate, would present fewer problems to the development of traditional communities.

American experience to date is different from that of the Russians and Danes and, in some respects, more limited. We have had only a need for the construction of specialized communities, first to support military and other government activities and now to permit oil production.

The military experience is particularly important as their work has been the foundation of current civilian practices. At present there are 53 military installations in Alaska, many of them in the Arctic. Since 1950, the U. S. Army Corps of Engineers has spent over $1 billion in the design,

construction, and repair of these facilities. In a very professional way, they faced up to and solved many of the technical problems encountered in the North; and, in the process, their thinking has evolved in a series of steps to the point where their effort now is to create an environment rather than adapt conventional structures to the environment. Initially, under the pressure of military need, they concentrated on providing shelter and operating facilities. Later these facilities were improved to increase efficiency and to provide a few amenities for operating personnel. Now they are in a third and more complex phase in which they must provide a proper human environment within a properly protected physical environment. They have come to this approach because the military, like the oil industry, needs to attract professional people and reduce turnover. Because of the critical cost factor, they also need to reduce maintenance and operating costs wherever possible. The answer to these problems has proven to be a single, composite building or series of interconnected buildings so that all activities are conducted in an enclosed environment. The construction of large buildings, or interconnected buildings, demands a more sophisticated understanding of environmental problems; and the Corps has achieved this as part of its solution of its construction problems.

This brings us to the oil industry and how it is handling its development problems along the arctic coast. The industry began by building separate airfields and base camps to handle each company's operations. These base camps are compact. As an example, Atlantic Richfield, as operator for itself and Humble Oil Company, has less than a square mile for its airport and camp facilities and about 71 acres for its dock and storage area. All camp facilities are interconnected so that they constitute a totally enclosed

community - a city in miniature. Also, because the oil fields can be unitized, road and well construction can be planned so as to provide maximum production with the fewest miles of road and pipelines and the fewest number of well sites. In summary, we have found that both economic and engineering requirements lead to a type of development that entails the least change in the environment. Before the discovery of oil ARCO operated out of a rough, temporary camp. After the first discovery well, the company constructed a second, though still temporary, camp. We are now just finishing a permanent camp complete with water system, sewage facilities, and airport and roads.

Where do we go from here? What can we look forward to in the Arctic?

First, no amount of economic development in the next decade is going to build big centers or a large population in northern Alaska. It is a vast area, larger than Montana. The oil development would have to increase more than fivefold to bring 25,000 people to the North Slope, but counteracting this factor is the fact that oil production takes fewer people than the initial development stage. Thus, while the opening of new areas to oil development will call for new communities such as we have at Prudhoe Bay, they will be specifically work camps, each manned by a few hundred people.

Hard mineral production could become important in the next decade, with each mining area requiring a supporting community of 5 to 7 thousand people. Allowing for five such communities, we can add 35,000 to the population of the North. But mining will almost surely be in the mountainous sections, and here the terrain and climate are on the whole much better than on the North Slope. The problems will be less severe, and the communities developed will look like those around the mines in the Yukon Territory of Canada.

The native economy and the native way of life will probably undergo major changes in the next decade. The challenge to match this change with sound community development is recognized by responsible people in the state and federal governments; but these changes will redistribute population more than they will increase it.

A major factor in all estimates of the future is transportation. Both we and the Russians have shown that a high-cost economic system can be built in the North on the basis of aviation alone. But we also know that surface transportation can materially reduce costs and make possible hard mineral production where it would not otherwise be possible. If Alaska pushes its road system northward and builds a railroad, it can maximize the development of the North. This will add to the population and the number of communities, but we are still talking about very few people in a vast land.

The conclusion seems to be that the North is not going to see great urban development. What is done must be done right, and we know how to do it right, whether we are industry or state or federal government. The real challenge is to plan well. It has been relatively easy for the military and the oil industry to build rationally following a master plan. Can we do it when we develop public transportation centers or rebuild native communities? The answer is "Yes" if we so will, and "will" in this context means the political process in action.

THE ROLE OF NAVAL PETROLEUM RESERVE NO. 4 ON THE NORTH SLOPE

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It is often said that the past is but the prologue to the future. Perhaps by looking at what has gone before on the North Slope we can make some projections as to the course of future events there.

The days were still fairly short and brisk winds off the Beaufort Sea continued the bitter cold on that spring day of 1917 when the eyes of Alexander Malcolm (Sandy) Smith were the first of a non-native to see large oil seepages near Cape Simpson. The seepages were confirmed in 1921. World War I had shown that our Navy would require immense quantities of oil and in 1923 the President established Naval Petroleum Reserve No. 4 in an effort to provide oil when and if needed. Cape Simpson was included within that reservation. The Navy thereupon requested the Geological Survey to examine and report upon Naval Petroleum Reserve No. 4. During the four years of 1923 to 1926 the Geological Survey, under financial sponsorship of the Navy, sent exploratory geologic and topographic parties into the Reserve, and the broad outlines of the general geology and topography of the area were worked out in a reconnaissance fashion.

From 1926 until 1943, Naval Petroleum Reserve No. 4 received little specific attention in the Navy Department. However, World War II - mechanized beyond previous imagination - required almost unbelieveable quantities

of petroleum products. Global distances shortened as better, faster, longer-range aircraft were developed. Necessary reliance on foreign imports in those days placed heavy and exacting demands on the Navy ships, aircraft, and men used in convoying oil to the United States. German submarines took a costly toll. In addition, we were called upon to furnish oil to our European allies. Severe rationing became necessary on the home front. Too, there was the heavy additional cost of rail tank car movement to take care of the West Coast and western Pacific oil requirements. To compound it all, the Japanese at the very beginning of the war cut off our crude rubber supplies, and our synthetic rubber industry - the manufacture of rubber from oil - had its beginning.

The whole pattern was such that there was need for a more complete knowledge of the petroleum potential of Naval Petroleum Reserve No. 4. Speculation about the Reserve and its possible petroleum resources took account of several possibilities: if the area contained large oil reserves, perhaps it would be possible to pipe the crude oil to the Pacific coast for shipment outside Alaska; maybe it should be refined in northern Alaska; possibly it could be used for Alaskan needs only, thereby saving the cost of transporting petroleum to Alaska; oil refined on the Reserve might provide products to supply bases in the Arctic; perhaps the oil would be refined in central Alaska or on the Pacific coast of Alaska and distributed from there. In January of 1943, the Secretary of the Interior issued Public Land Order 82 which withdrew all of Alaska north of the Brooks Range, among other parts of Alaska, from all forms of entry for use in the prosecution of the war.

In March of 1943, Lt. W. T. Foran, a Naval Reserve officer, prepared

a memorandum in which he set forth some reasons for taking a more detailed look at Naval Petroleum Reserve No. 4. After careful consideration by the Navy and interpretation of plans with the Department of Interior, it was decided in the winter of 1944 with the personal concurrence of President Roosevelt to send a small reconnaissance party to the Reserve. The departure of Lt. Foran's party in March, 1944 was the birth of the exploration program that soon came to be known as "Pet-4."

Pet-4 continued from March, 1944 for almost ten action-packed years of petroleum exploration. For the first few years Pet-4 was a Naval Construction Battalion operation, but with the end of the war, followed by the general rush toward demobilization, it was decided to change as rapidly as possible to a civilian contract operation. The program was fully recessed in the fall of 1953. It had been successful in yielding a wealth of technical information sufficient for a partial appraisal of the petroleum reserves in large parts of the entire North Slope. These reserves are substantial. One major and two minor oil fields, six gas fields, and numerous "shows" of oil were discovered. An outstanding product of Naval Petroleum Reserve No. 4 was the acquisition of a vast store of know-how in arctic operations in many fields. Much was learned, for example, about providing livelihood and liveable working conditions for substantial numbers of men previously inexperienced in the Arctic and about transportation of personnel, equipment, and supplies in summer and winter by water, air, and land. Geological and geophysical exploration covered substantially the entire North Slope. At the insistance of the Office of Naval Petroleum and Oil Shale Reserves, and with funding by it, all of these data were published and placed on file for the use of the general public by the Geological Survey; and these records have

been an invaluable aid to the present exploration of the North Slope by industry.

The operations of Naval Petroleum Reserve No. 4 originally grubstaked the Navy's Arctic Research Laboratory located within the Reserve at Point Barrow. This represented an early recognition by the Navy of the need for studying the problems created by the hostile arctic environment. As the years have passed that laboratory has continued to be the best friend of the ecologist, the conservationist, and the oil explorer in the Alaskan Arctic; and, as activity heightens all along the Slope, the Navy's Arctic Research Laboratory has a great and continuing role to play in assisting America to find that happy accommodation between reasonable development of resources and protection of the natural environment.

Following the cessation of exploratory activities by the Navy on the North Slope, Public Land Order 82 was modified to return those lands outside the Reserve to the public domain. Eventually some of the lands passed to the State of Alaska and were subsequently leased out at the celebrated sales held by the State of Alaska. As you all know, it is on those leased lands that recent prolific discoveries have been made.

By a special law of 1962, the Navy was authorized to develop the South Barrow Gas Field and to supply gas to the native village of Barrow as well as to the various federal activities located there. Presently, there are four producing wells there and another development well is planned for next month. Practically all of the Navy's Naval Petroleum Reserve No. 4 drilling rigs and equipment were eventually sold to private interests.

The discovery of oil in areas outside the Reserve has naturally

prompted a renewed interest in the potential of the Reserve itself. Such questions as the risk of drainage, the prospects of the deeper horizons, and the problems of boundaries combined at the same time with overriding questions as to the sufficiency of oil in reserve for national emergencies all tend to suggest a re-evaluation of the government's interest in that Reserve.

When we talk about the security implications of Naval Petroleum Reserve No. 4 oil, I think we should talk in the fuller sense of the security implication of all the North Slope or, better yet, the implications to continental security of both Alaskan and Canadian arctic oil. It also would seem to me that the concept of emergency preparedness carries with it a connotation of reserve deliverability. In this connection, it must be kept in mind that the infrastructure of a viable, prosperous domestic oil industry will, as always, be our chief fuel provider in times of national peril. The total of approximately one billion dollars paid by industry for state leases on the Slope at last September's sale and the plans of industry to spend a billion plus dollars on one piepline and the costly Manhattan project cannot help but instill in us all admiration for an industry willing to assume unprecedented financial risks in seeking new sources of oil. Considering that the prospect of a pay-out is some years hence, we must agree that business statesmanship and courage of this calibre have seldom been demonstrated as they have in Alaska.

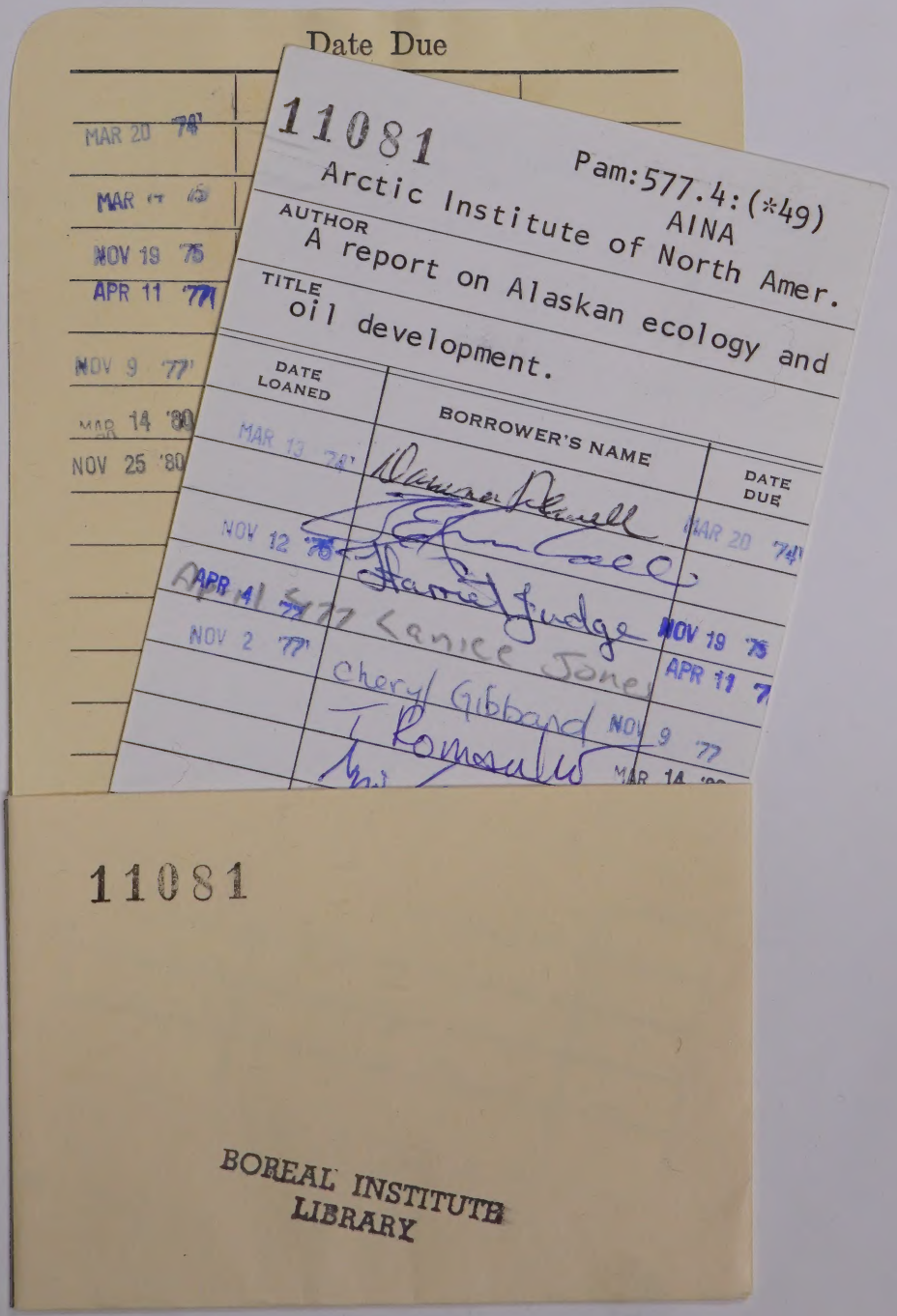
Much of the case of the oil industry for a fair depletion allowance and import quotas has been based on, and quite rightly so, the need for reserves of crude oil for national emergencies within the United States. Must the oil industry be expected to undertake the principal burden of providing spare capacity? Generally, it is to be noted that spare capacity is

a temporary phenomenon, normally eliminated within a year or two following major new discoveries outside the "market demand" states. Thus, Texas and Louisiana are the only two states with significant spare capacity at the present time. Many authorities maintain that the prevailing system of conservation regulations cannot be depended on to produce and maintain indefinitely any particular amount of reserve capacity in aid of national security. Others argue that the government, as the unit charged with responsibility for national security, should set aside petroleum reserves to be drawn upon in the event of emergency. In effect, these authorities are saying that government should stockpile petroleum for defense, as it has done with other strategic minerals and products, utilizing the natural and efficient storage facility provided by the native reservoir. Under such a proposal they assert that the nation can secure and maintain indefinitely a reserve of the precise size desired on national security grounds. The reserve can be made to grow, if desired, so as to maintain a constant ratio of reserve to demand, balanced by imports. They argue effectively that the proposal would place where it belongs the financial burden of maintaining an untapped reserve capacity. Since the objective is national security, they say, the burden falls to the federal government proximately and the general taxpayer ultimately, not to the petroleum industry proximately and landowners and product consumers ultimately. There is a fear that if the cost is borne involuntarily by industry, industry will make adjustments that jeopardize the objective. They argue additionally that a government oil reserve program of proper magnitude would free the industry of the threat to prices and access to markets posed by an overhang of industry's own spare capacity.

On the North Slope at the present time it would seem that industry will

get a faster pay-out if the market is not glutted by the dumping of more public lands - state or federal - for leasing. If the market is not so glutted, it would seem that the price of oil would achieve greater stability and both state and federal governments could expect greater revenues from lands offered for leasing at the appropriate time.

As to the future of Naval Petroleum Reserve No. 4, it is strictly a responsibility of the Congress. We can only assume that the laws affecting that Reserve will be continued as they are presently written and the Navy would have no plans for the Reserve other than as authorized by these laws for about a half a century. The Navy has been assigned the stewardship of the Reserve not just for the Navy, but for the nation as a whole. Perhaps within the context of the considerations mentioned above, it would seem that in any eventuality Naval Petroleum Reserve No. 4 will have an influential role in oil development on the North Slope in the future as it has in the past.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